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DARWIN'S CORRESPONDENCE WITH JAMES DRUMMOND

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Charles Darwin (1809 -1882) visited Western Australia during the voyage of the *Beagle*, 7 — 14 March 1836, after short sojourns in New South Wales (January, 1836), and Tasmania (February, 1836). Darwin did not especially *like* any part of Australia, and left the continent "without sorrow or regret"; the scenery of the area around King George's Sound, he felt, was particularly uninspiring (Armstrong, 1985, 1988; Nicholas and Nicholas, 1988). Nevertheless, the southern continent, and its plants, animals, Aboriginal inhabitants and some of its landscapes were of considerable interest to him, and he frequently referred to these in his later work. He also corresponded with a of number of Australian naturalists throughout a good deal of his later scientific career. He sought information from them on various matters, and was also able to assist them with their enquiries. Amongst these correspondents was James Drummond (1784-1863), who had accompanied Captain James Stirling to the Swan River Colony in 1829 as Naturalist (Erickson, 1969). The correspondence does not seem to have been discussed to any extent heretofore, and as it of considerable local interest and also of some significance in the overall pattern of Darwin's work, I quote it here in some detail. But first the circumstances in which the correspondence took place should be noted.

The Origin of Species had been published late in 1859, just a few months before the commencement of the exchange, and the implications of the work were still being absorbed by the scientific community: the famous British Association debate took place at Oxford in the summer of 1860. Darwin's work on pollination was proceeding apace, documented in detail in note-books now held in the Darwin Archive in Cambridge (especially in an "Experimental Book" (DAR 157 a) which is a diary of his experiments on plants between November 1855 and about May 1868). In April 1860 he received some living *Lechenaultia formosa* from his close friend and scientific colleague Dr J D Hooker (1817-1911) of Kew Gardens, and throughout the spring and early summer of that year he undertook experiments, artificially pollinating them with a camel hair brush, recording every stage in minute detail, often including his thoughts alongside his observations:

> Unless Bees open indusium in search of pollen, & so carry it from flower to flower, I see no way of crossing — I have seen Humble-Bees open growing Honey-suckle flowers, so at least possible. (28 April 1860)

The experiments posed as many problems as they solved, and on 9 May 1860 Darwin wrote to his old friend:

> My dear Hooker
>
> Do you by any chance to know any observing man living in the country (whatever country that may be) inhabited by Leschenaultia formosa? I am very unhappy about this flower & I can "wriggle out" of my difficulty by supposing that Bees go from flower to flower & open the indusium. I know that Bees will do more difficult work for pollen. Our English Bees will not look at the flower. I would write & supplicate anyone (& use your name as Introduction) if any naturalist lives in (the) country of Leschenaultia, to watch the Bees at work.
>
> (Cambridge University Library Darwin Archive, DAR 115(ii)/52)

Hooker immediately suggested James Drummond, and a few days later, on 16 May 1860, Charles Darwin wrote to him from the Darwin family home at Down in Kent (the original is in the Battye Library, Perth, at 2275A (2); the letter is the hand of an amanuensis, but signed by Darwin) as follows:

> Dear Sir,
>
> I hope that you will excuse the liberty which I take in writing to you and asking you a favour. Dr Hooker has told me that I may use his name as an introduction. I am very curious about the fertilisation of Leschenaultia formosa. I must just allude to its structure, though no doubt you are well acquainted with it.
>
> The indusium or cup at the summit of the pistil is open in the bud, but before the flower opens the indusium closes and in closing includes nearly all the pollen. In my greenhouse the indusium never opens again. The pollen within the indusium is enclosed near the lips, and not a grain lies, as I find, on the stigmatic surface at the bottom of the indusium. How then is this plant fertilised? My belief is that insects in creeping in to suck the copious nectar, brush open the indusium, and the hairs of their abdomens stir up the pollen and push it down on the stigmatic surface. I find this easily effected by a camel hair brush.
>
> Now what I want to beg is for you to have the great kindness to watch for a short time the Leschenaultia and see whether Bees visit it; and if they do, to endeavour to observe whether in crawling in or whilst sucking, they do not open the lips of the indusium. As this plant may be visited by nocturnal insects, it would be a very interesting experiment to cover over with a bag or frame of *very open* gauze one or two plants (plucking off any open flowers) and then see whether they seed at all or less freely than plants left to the visits of insects. This may appear a trifling enquiry to you; but the subject has been largely discussed by R. Brown, Aug: St. Hilaire and other celebrated Botanists; and Dr Hooker and I are experimenting on the subject. If any other Goodenaceae, furnished with an indusium, grow near you, I should be infinitely obliged for any notices on their structure in relation to the following point,. "how in one flower is it possible that pollen from another flower or plant of the same species could get into the indusium", I have strong reason to believe this is a universal possibility. In the Leschenaultia, if insects open the indusium in the manner which I suspect, their abdomens dusted with pollen from one flower might easily carry grains into the indusium of another flower.
>
> I hope that you will excuse the liberty I take in begging this favour and I remain, Dear Sir, Your obliged Servant Charles Darwin.

(Even in his publications Darwin used the spelling *Leschenaultia,* this spelling being usual from 1837 until the 1960s — see Morrison, 1987). James Drummond sent quite a long reply to this (the original is in the American Philosophical Society collection, Philadelphia, No 20353). From Hawthornden Farm (in the Toodyay Valley, about 80km from Perth, and named after the Drummond ancestral home in Scotland) on 17 September 1860 he wrote:

> Dear Sir,
>
> In compliance with your request, I have paid particular attention to the *Goodeniaceous* plants which I have met with in flower. Since I received your letter, I met with *Lechenaultia grandiflora* in abundance covering the flat top of an ironstone Gravelly hill several acres in extent and so profusely covered with flowers of this beautiful plant that the whole surface of the ground seems of a blue colour from its blossoms, but I have not been able to learn much relating to the genus which you have not found by observing L Formosa in your greenhouse, the pollen leaves the anthers long before the flower opens, just when the lips of the indusical cup reaches as high as the filamen(t)s which support the anthers, it therefor (sic) receives almost Their whole contents, when the cup is open to the crown of the German it is here no doubt impregnation takes place whenever it does take place but that *comparatively speaking,* is a very rare event in the plants of this genus. I may safely say that one (plant *deleted*) seed vessel in 500. I would probably be within bounds if I said 5000 even under any circumstances is fertilised by the pollen *and comes to* maturity, the Lechenaultias are all creeping rooted plants at least all the ornamental species. They are altogether independent of seeds for their reproduction.
>
> I have been more successful in other genera of this family the curious Genus Distylis a yellow flowered annual plant growing in this neighbourhood shows clearly the Economy of this family of plants, to understand it the flower bud must be taken very young long before the flower & plant, I then find the double cupped Indusium which can only be considered two branches of the style, has just risen to the height of the filaments of the anthers, which support the anthers and filaments are closely invested by the unexpanded corolla at this stage (the whole *deleted)* therefore the whole of the pollen contained in the anthers is discharged into the indusical cups and it is evident in this plant that impregnation imedeately (sic) takes place, as the seeds which are many in number and large for the size of the plant very soon begin to enlarge, by the time the flower opens, the two indusical cups are generally altered in appearance they look like two simple *ciliated filaments* but, by the time the German is considerably enlarged. I have made observations on another curious *annual* genus of this order, the capsule of which contains two seeds very large for the size of the plant, resembling Grevillea in the way they lie in the seed vessel, each seed is furnished with a broad wing which goes all round the seeds. I have examined 2 species I do not know the *name* of the genus, I shall try and send you seeds of these two species and *Distylis.*
>
> The Economy with regard to the Anthers and Indusium is exactly the same, as is *Distylis,* neither of them are ornamental plants but I think they will clearly explain the Mystery about the impregnation of the Goodeniaceae. I have not yet been able to make any observations on

> *Brunoniae,* the habbitat (sic) I know near my residence had been destroyed by a flock of sheep grazing over it, and I have not yet found another.
>
> I am Sir,
> Your obedient Humble Servant
> James Drummond

(The punctuation and emphasis, etc, are as far as possible as in the original. Drummond wrote with a bold, rounded, authoritative hand — much clearer than that of Darwin — but his punctuation and orthography were somewhat individual. Taxonomy has of course changed considerably since Darwin's and Drummond's day. *Lechenaultia grandiflora* is now called *L. biloba:* for the most recent treatment of the taxonomy of the genus, see Morrison (1987). The genus *Distylis* is a synonym of *Calogyne;* however it is likely that Drummond was referring to a species of *Goodenia.* The *Brunonia* mentioned is *B. australis,* sometimes placed in its own family — Brunoniaceae.)

On 22 November, Darwin wrote back from his home at Down (Battye Library 2275A (3)):

> Dear Sir,
>
> I am extremely much obliged to you for your second interesting letter of Sept. 17th — what you state about the Leschenaultias not seeding is surprising; but from my experiments I cannot get it out of my head that the agency of insects, though not perhaps indispensable, to their fertilisation, yet is useful to them.
>
> You do not mention, but I would like to know the simple fact whether the flowers of Leschenaultia (or other Goodeniaceae) are visited by Bees or other insects. Your offer to send me seeds of Distylis & the other genus, will be of the greatest possible interest to me.
>
> With sincere thanks for your great kindness, I beg leave to remain, Dear Sir,
>
> Yours sincerely obliged,
> Charles Darwin.

But before Charles Darwin had received the first of his letters, James Drummond was writing again. This letter is in the Darwin Archive in Cambridge at DAR 162 II/242. The original is much damaged, having at some stage been eaten by insects, and possibly other vermin. Below is an attempt at a partial reconstruction, the brackets generally representing suggestions as to the missing material:

> Hawthornden Farm
> October 8th 1860
>
> Dear Sir,
>
> Since I wrote to you by the last mail for England, I have met Brunonia in flower, & (*missing*) ...s anxious to see it as I perceive (*missing*) ...t Dr Linley has made it a (separate) Order, whatever other (resembl)ances May exist between it (& Goo)deniaceae, it agrees with it (in the r)emarkable character of (its an)thers discharging their pollen some days before the flower expands in Brunonia the stigma surrounded by the open indusium, passes up between the anthers when discharging

> (its) pollen, & when the flower opens (it)s stigma is seen with the lips of the indusium closed over but in this genus there are no overlapping ciliae, and it is easily opened. I observed a small bee bussily (sic) employed in extracting the pollen but I suppose there is always e(nough) left to fertilise the th(e) seed.
>
> ...
>
> I inclose (sic) you a few seeds of the curious genus Distylis if they grow with you I think (i)t will clearly explain the (wh)ole curious process of fertilisation in this family. What appear as two very questionable styles when the flower opens are seen when examined early enough to be two (beautiful *del)* funnel shaped menbranes beautifully adapted for the use for which evidently (intended) to convey the pollen to the st(igma) in this genus and the two species of another which I described (in) my last letter. ... I have observed a curious property in the seeds of Disty(lis), whenever they happen to lie (when) the first shower of rain (falls) on them, earth stones Gum leaves &c they adhere firmly by a sort of gummy matter, which surrounds the seed.

Amongst the other botanical curiosities Drummond mentioned in this letter were seeds of a flower from the group Compositae which attached themselves to the soil "by their lower end, at the same time setting themselves perfectly upright", and "a curious Malvaceous ... plant" that was apparently self-fertilised although the flower never fully developed.

A month after his second letter, Darwin wrote again (2275A(4), see Fig 1), in reply to the above, which had crossed with his communication of 22 November:

> Dec. 20 Down, Bromley, Kent
>
> Dear Sir,
>
> I received your extremely interesting letter of Oct 8th this morning. I thank you much for the Distylis seeds which I will plant in greenhouse in the spring. I will also have the pleasure of examining the seed of the Compos. plant which you describe as so remarkable.
>
> It seems a trifling point, but I have been *extremely* much interested by what you tell me of the small Bee extracting the pollen from within the indusium of the Brunonia. If you have any opportunity of observing, I should so much like to hear whether Bees do the same for Leschenaultia; or whether, as I suspect, in sucking the nectar of the flowers, their hairy abdomens do not brush over & partly open the slightly protuberant upper lip of the indusium. Another fact which you mention has interested me particularly, namely the Malvaceous plant setting seed with its flower never opening. I have observed something of this in Drosera rotundifolia & in Chlora perfoliata.
>
> Have you observed the Malvaceous plant living more than one year? And are you sure that it has not *two* periods of flowering (like some Campanulas) at one period opening its flowers & another not opening them.
>
> Pray accept my cordial thanks for your great kindness, & believe me,
>
> Dear Sir,
> Yours truly obliged,
> Charles Darwin.

PS I have kept back this note for a couple of days just to say I have been watching the achenia of the Stylincerus(?) plant on damp paper. The vesicles which contain the dried mucus seem to me a pretty & curious adaptation; & the whole object very pretty under the microscope. I

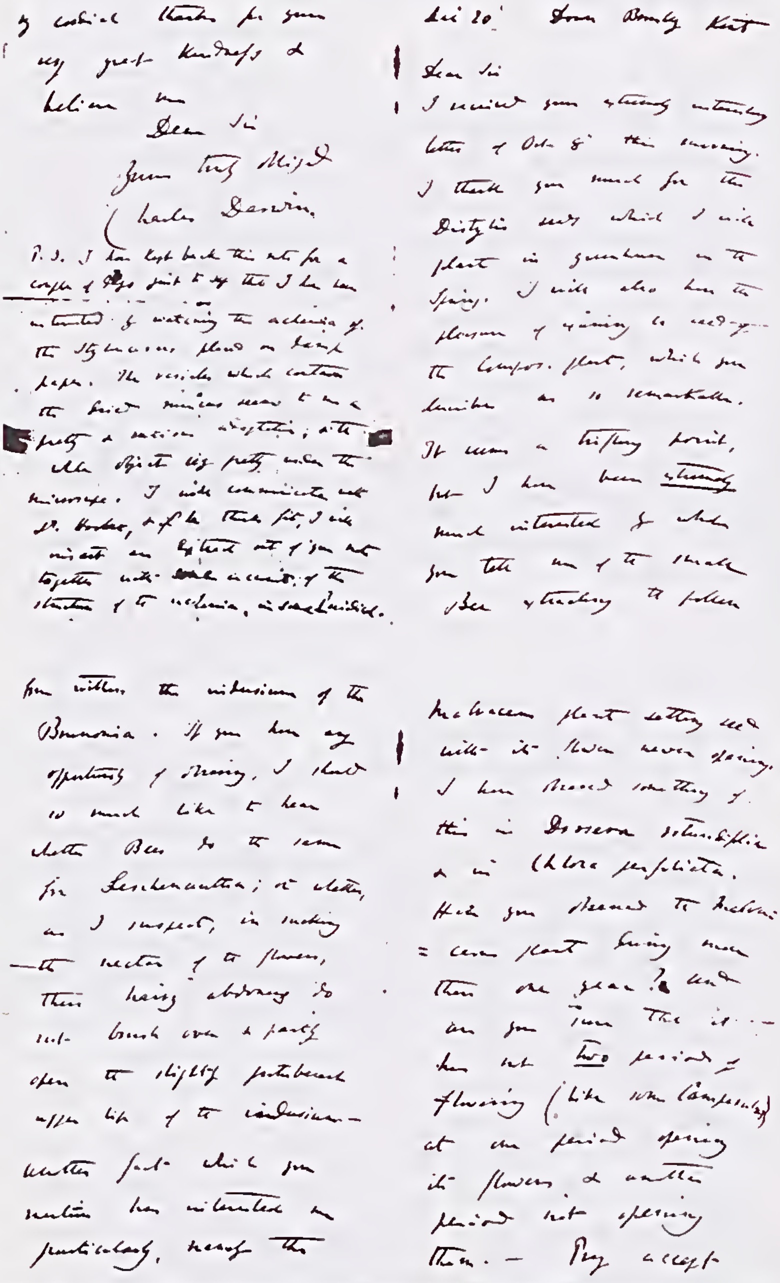

Fig. 1. Letter from Charles Darwin to James Drummond, 20 December 1860; Battye Library, Perth. The original was written on both sides of a single folded sheet of paper. Thus the top right represents side one, bottom left side two, bottom right side three, and top left side four.

> will communicate with Dr Hooker, & if he thinks fit, I will insert an extract of your note together with some account of the structure of the achenia, in some periodical.

Darwin was as good as his word: in a short note to the *Journal of Horticulture and Cottage Gardener* (28 May 1861, 1, 151), as part of a correspondence on the rarity of self-pollination in flowers, he wrote:

> *Leschenaultia formosa* has apparently the most effectual contrivance to prevent the stigma of one flower ever receiving a grain of pollen from another flower; for the pollen is shed in the early bud, and is there shut up round the stigma within a cup or indusium.

Darwin went on to describe his experiments:

> ... I found by holding a camel-hair pencil parallel to the pistil, and moving it as if it were a bee going to suck the nectar, the straggling hairs of the brush opened the lip of the indusium, entered it, stirred up the pollen and brought out some grains. I did this to five flowers and marked them. These five flowers all set pods; whereas only two other pods set on the whole plant, though covered with innumerable flowers. ... I became so strongly convinced that insects would be found concerned in the fertilisation of these flowers that I wrote to Mr James Drummond, at Swan River in Australia, and asked him to watch the flowers of plants of this order; and he soon wrote to me that he had seen a bee cleverly opening the indusium and extracting pollen; and a bee with its mandibles thus covered with pollen would very likely effect a cross between one individual and another of the same species.

Darwin's work on pollination led to his reading of his important paper: "On the Two Forms, or Dimorphic Condition, in the Species of *Primula*, and Their Remarkable Sexual Relations" to the Linnean Society on 21 November 1861 (Darwin, 1862a) — his "Experimental book" and correspondence with Hooker show that work on cowslips (*Primula veris*) and primroses (*Primula vulgaris*) had been proceeding in tandem with his work on *Lechenaultia*. His important *Fertilisation of Orchids* appeared in the same year (Darwin, 1862b).

The nature of sexual reproduction is of course fundamental to evolutionary theory, and was considered in some detail in some of Darwin's later work such as *The Descent of Man and Selection in Relation to Sex*, in 1871.

His work on the association between insects and flowers, in the beautiful West Australian genus *Lechenaultia* and related members of Goodeniaceae, in the primroses of the hedgerows around Darwin's home at Down, and later in a range of exotic orchids, was eventually to provide the basis of the development of ideas on co-evolution — the evolution of communities of associated organisms. The correspondence between two enthusiastic botanist-gardeners, one in the Kent countryside, the other a world away at his farm in the Toodyay Valley, had a tiny part to play in the development of some of the most important notions of modern science.

I thank the Battye Library, Perth for access to originals of their Darwin letters, and for making available the print from which Fig 1 was made. Work in Cambridge and Philadelphia was undertaken while I was on study-leave from the University of Western Australia, and partly supported by the National Geographic Society (Washington). I thank Joe Gentilli for his comments on a draft of this paper. I also thank an anonymous referee for detailed comments on the modern taxonomy on some of the Western Australia plant species mentioned.

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NATURAL HISTORY NOTES ON LIZARDS FROM THE ROE PLAIN, WESTERN AUSTRALIA

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INTRODUCTION

As part of a six week lizard collecting field trip to Western Australia during late spring and early summer of 1989, we spent six days (5-10 November) working at several localities on the Roe Plain in southeastern Western Australia. Previous reports on the reptiles of this area are largely restricted to checklists with locality data and "where found" ecological data (Martindale 1980; Storr *et al.*, 1981; Dyer 1985, and Congreve 1985). We present here a brief resume of some basic natural history information on the reptiles, mostly agamid and scincid lizards, we encountered, with special emphasis on reproduction, size and colour features.